

What is claimed is:

1. An isolated GapC protein selected from the group consisting of:

5 (a) an isolated *Streptococcus dysgalactiae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figure 1A-1B (SEQ ID NO:4);

(b) an isolated *Streptococcus agalactiae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 2A-2B (SEQ ID NO:6);

10 (c) an isolated *Streptococcus uberis* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 3A-3B (SEQ ID NO:8);

(d) an isolated *Streptococcus parauberis* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 4A-4B (SEQ ID NO:10);

15 (e) an isolated *Streptococcus iniae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 5A-5B (SEQ ID NO:12); and

20 (f) immunogenic fragments of (a), (b), (c), (d) and (e) comprising at least about 5 amino acids.

2. The isolated GapC protein of claim 1, wherein the protein is a *Streptococcus dysgalactiae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 1A-1B (SEQ ID NO:4).

25 3. The isolated GapC protein of claim 1, wherein the protein is a *Streptococcus agalactiae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 2A-2B (SEQ ID NO:6).

4. The isolated GapC protein of claim 1, wherein the protein is a *Streptococcus uberis* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 3A-3B (SEQ ID NO:8).

5 5. The isolated GapC protein of claim 1, wherein the protein is a *Streptococcus parauberis* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 4A-4B (SEQ ID NO:10).

10 6. The isolated GapC protein of claim 1, wherein the protein is a *Streptococcus iniae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 5A-5B (SEQ ID NO:12).

15 7. An isolated polynucleotide comprising a coding sequence for the isolated GapC protein of claim 1 or complements thereof.

 8. An isolated polynucleotide comprising a coding sequence for the isolated *Streptococcus dysgalactiae* GapC protein of claim 2 or complements thereof.

20 9. The isolated polynucleotide of claim 8, wherein said coding sequence is the coding sequence shown at nucleotide positions 1 to 336, inclusive, of Figures 1A-1B (SEQ ID NO:3).

 10. An isolated polynucleotide comprising a coding sequence for the isolated *Streptococcus agalactiae* GapC protein of claim 3 or complements thereof.

25 11. The isolated polynucleotide of claim 10, wherein said coding sequence is the coding sequence shown at nucleotide positions 1 to 336, inclusive, of Figures 2A-2B (SEQ ID NO:5).

12. An isolated polynucleotide comprising a coding sequence for the isolated *Streptococcus uberis* GapC protein of claim 4 or complements thereof.

5 13. The isolated polynucleotide of claim 12, wherein said coding sequence is the coding sequence shown at nucleotide positions 1 to 336, inclusive, of Figures 3A-3B (SEQ ID NO:7).

10 14. An isolated polynucleotide comprising a coding sequence for the isolated *Streptococcus parauberis* GapC protein of claim 5 or complements thereof.

15 15. The isolated polynucleotide of claim 14, wherein said coding sequence is the coding sequence shown at nucleotide positions 1 to 336, inclusive, of Figures 4A-4B (SEQ ID NO:9).

20 16. An isolated polynucleotide comprising a coding sequence for the isolated *Streptococcus iniae* GapC protein of claim 6 or complements thereof.

25 17. The isolated polynucleotide of claim 16, wherein said coding sequence is the coding sequence shown at nucleotide positions 1 to 336, inclusive, of Figures 5A-5B (SEQ ID NO:11).

18. A recombinant vector comprising:
(a) the isolated polynucleotide of claim 7; and
(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

19. A recombinant vector comprising:
(a) the isolated polynucleotide of claim 8; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

5 20. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 9; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

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21. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 10; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

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22. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 11; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

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23. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 12; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

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24. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 13; and

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(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

5 25. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 14; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

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26. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 15; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

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27. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 16; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

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28. A recombinant vector comprising:

(a) the isolated polynucleotide of claim 17; and

(b) at least one heterologous control element operably linked to said isolated polynucleotide, whereby said coding sequence can be transcribed and translated in a host cell, and at least one of said control elements is heterologous to said coding sequence.

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29. A host cell comprising the recombinant vector of claim 18.

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30. A host cell comprising the recombinant vector of claim 19.

31. A host cell comprising the recombinant vector of claim 20.

5 32. A host cell comprising the recombinant vector of claim 21.

33. A host cell comprising the recombinant vector of claim 22.

34. A host cell comprising the recombinant vector of claim 23.

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35. A host cell comprising the recombinant vector of claim 24.

36. A host cell comprising the recombinant vector of claim 25.

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37. A host cell comprising the recombinant vector of claim 26.

38. A host cell comprising the recombinant vector of claim 27.

39. A host cell comprising the recombinant vector of claim 28.

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40. A method for producing a GapC protein, said method comprising culturing the cells of claim 29 under conditions for producing said protein.

25 41. A method for producing a GapC protein, said method comprising culturing the cells of claim 30 under conditions for producing said protein.

42. A method for producing a GapC protein, said method comprising culturing the cells of claim 31 under conditions for producing said protein.

43. A method for producing a GapC protein, said method comprising culturing the cells of claim 32 under conditions for producing said protein.

5 44. A method for producing a GapC protein, said method comprising culturing the cells of claim 33 under conditions for producing said protein.

45. A method for producing a GapC protein, said method comprising culturing the cells of claim 34 under conditions for producing said protein.

10 46. A method for producing a GapC protein, said method comprising culturing the cells of claim 35 under conditions for producing said protein.

15 47. A method for producing a GapC protein, said method comprising culturing the cells of claim 36 under conditions for producing said protein.

48. A method for producing a GapC protein, said method comprising culturing the cells of claim 37 under conditions for producing said protein.

20 49. A method for producing a GapC protein, said method comprising culturing the cells of claim 38 under conditions for producing said protein.

50. A method for producing a GapC protein, said method comprising culturing the cells of claim 39 under conditions for producing said protein.

25 51. A vaccine composition comprising a pharmaceutically acceptable vehicle and a GapC protein, wherein said GapC protein is selected from the group consisting of:

(a) a *Streptococcus dysgalactiae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 1A-1B (SEQ ID NO:4);

(b) a *Streptococcus agalactiae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 2A-2B (SEQ ID NO:6);

(c) a *Streptococcus uberis* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 3A-3B (SEQ ID NO:8);

5 (d) a *Streptococcus parauberis* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 4A-4B (SEQ ID NO:10);

(e) a *Streptococcus iniae* GapC protein comprising the amino acid sequence shown at amino acid positions 1 to 336, inclusive, of Figures 5A-5B (SEQ ID NO:12);

10 (f) a *Streptococcus* GapC protein having at least about 70% sequence identity to (a), (b), (c), (d) and (e); and

(g) immunogenic fragments of (a), (b), (c), (d), (e) and (f), said fragments comprising at least about 5 amino acids.

15 52. The vaccine composition of claim 51, wherein said GapC protein comprises the amino acid sequence of the *Streptococcus dysgalactiae* GapC protein depicted at amino acid positions 1 to 336, inclusive, of Figures 1A-1B (SEQ ID NO:4) or an immunogenic fragment thereof, said fragment comprising at least about 5 amino acids.

20 53. The vaccine composition of claim 52, wherein said GapC protein comprises the amino acid sequence depicted at amino acid position 1 to 336, inclusive, of Figures 1A-1B (SEQ ID NO:4).

25 54. The vaccine composition of claim 51, wherein said GapC protein comprises the amino acid sequence of the *Streptococcus agalactiae* GapC protein depicted at amino acid positions 1 to 336, inclusive, of Figures 2A-2B (SEQ ID NO:6) or an immunogenic fragment thereof, said fragment comprising at least about 5 amino acids.

55. The vaccine composition of claim 54, wherein said GapC protein comprises the amino acid sequence depicted at amino acid positions 1 to 336, inclusive, of Figures 2A-2B (SEQ ID NO:6).

5 56. The vaccine composition of claim 51, wherein said GapC protein comprises the amino acid sequence of the *Streptococcus uberis* GapC protein depicted at amino acid positions 1 to 336, inclusive, of Figures 3A-3B (SEQ ID NO:8) or an immunogenic fragment thereof, said fragment comprising at least about 5 amino acids.

10 57. The vaccine composition of claim 56, wherein said GapC protein comprises the amino acid sequence depicted at amino acid positions 1 to 336, inclusive, of Figures 3A-3B (SEQ ID NO:8).

15 58. The vaccine composition of claim 51, wherein said GapC protein comprises the amino acid sequence of the *Streptococcus parauberis* GapC protein depicted at amino acid positions 1 to 336, inclusive, of Figures 4A-4B (SEQ ID NO:10) or an immunogenic fragment thereof, said fragment comprising at least about 5 amino acids.

20 59. The vaccine composition of claim 58, wherein said GapC protein comprises the amino acid sequence depicted at amino acid positions 1 to 336, inclusive, of Figures 4A-4B (SEQ ID NO:10).

25 60. The vaccine composition of claim 51, wherein said GapC protein comprises the amino acid sequence of the *Streptococcus iniae* GapC protein depicted at amino acid positions 1 to 336, inclusive, of Figures 5A-5B (SEQ ID NO:12) or an immunogenic fragment thereof, said fragment comprising at least about 5 amino acids.

30 61. The vaccine composition of claim 60, wherein said GapC protein comprises the amino acid sequence depicted at amino acid positions 1 to 336, inclusive, of Figures 5A-5B (SEQ ID NO:12).

62. The vaccine composition of claim 51, further comprising an adjuvant.

63. A method of producing a vaccine composition comprising the steps of

- 5 (1) providing a GapC protein or an immunogenic fragment thereof, said fragment comprising at least about 5 amino acids, and
(2) combining said protein with a pharmaceutically acceptable vehicle.

64. A method of treating or preventing a bacterial infection in a vertebrate subject
10 comprising administering to said subject a therapeutically effective amount of a vaccine composition according to claim 51.

65. The method of claim 64, wherein said bacterial infection is a streptococcus
infection.

66. The method of claim 65, wherein said bacterial infection causes mastitis.

67. A method of treating or preventing a bacterial infection in a vertebrate subject
comprising administering to said subject a therapeutically effective amount of a
20 polynucleotide according to claim 7.

68. The method of claim 67, wherein said bacterial infection is a streptococcal
infection.

69. The method of claim 68, wherein said bacterial infection causes mastitis.

70. Antibodies directed against the isolated GapC protein of claim 1.

71. The antibodies of claim 70 wherein said antibodies are polyclonal.

72. The antibodies of claim 70 wherein said antibodies are monoclonal.

73. A method of detecting *Streptococcus* antibodies in a biological sample, comprising:

- 5 (a) reacting said biological sample with an isolated GapC protein under conditions which allow said *Streptococcus* antibodies, when present in the biological sample, to bind to said GapC protein to form an antibody/antigen complex; and
- (b) detecting the presence or absence of said complex, thereby detecting the presence or absence of *Streptococcus* antibodies in said sample.

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74. The method of claim 73, wherein said GapC protein is the protein of claim 1.

75. A method of detecting a GapC protein in a biological sample, comprising:

- 15 (a) reacting said sample with antibodies directed against the GapC protein under conditions which allow said antibodies to bind to said GapC protein, when present in the sample, to form an antibody/antigen complex; and
- (b) detecting the presence or absence of said complex, thereby detecting the presence or absence of a GapC protein in said sample.

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76. An immunodiagnostic test kit for detecting *Streptococcus* infection, said test kit comprising a GapC protein and instructions for conducting the immunodiagnostic test.

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77. An immunodiagnostic test kit for detecting *Streptococcus* infection, said test kit comprising antibodies directed against a GapC protein and instructions for conducting the immunodiagnostic test.